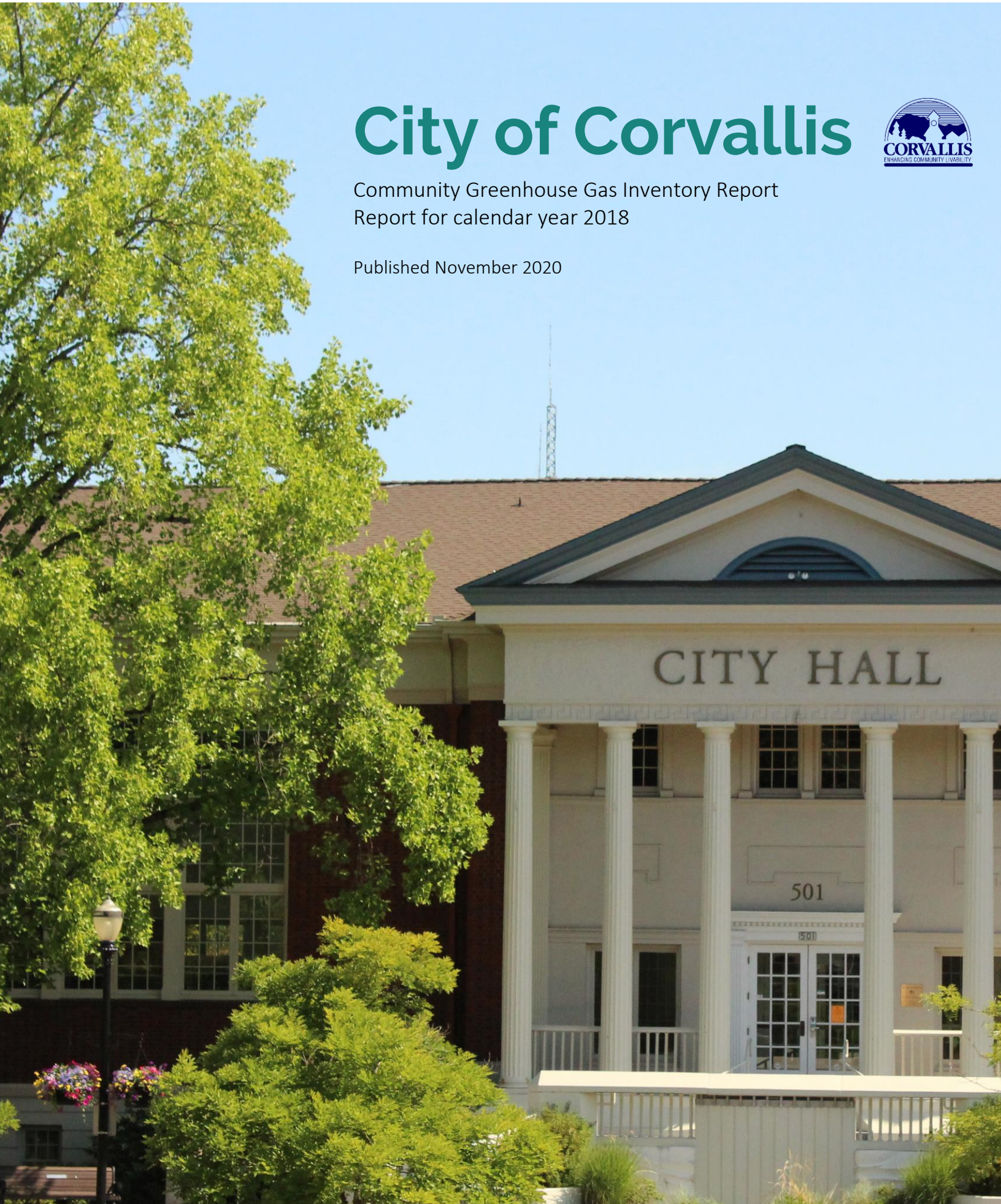
City of Corvallis

Community Greenhouse Gas Inventory Report
Report for calendar year 2018

Published November 2020



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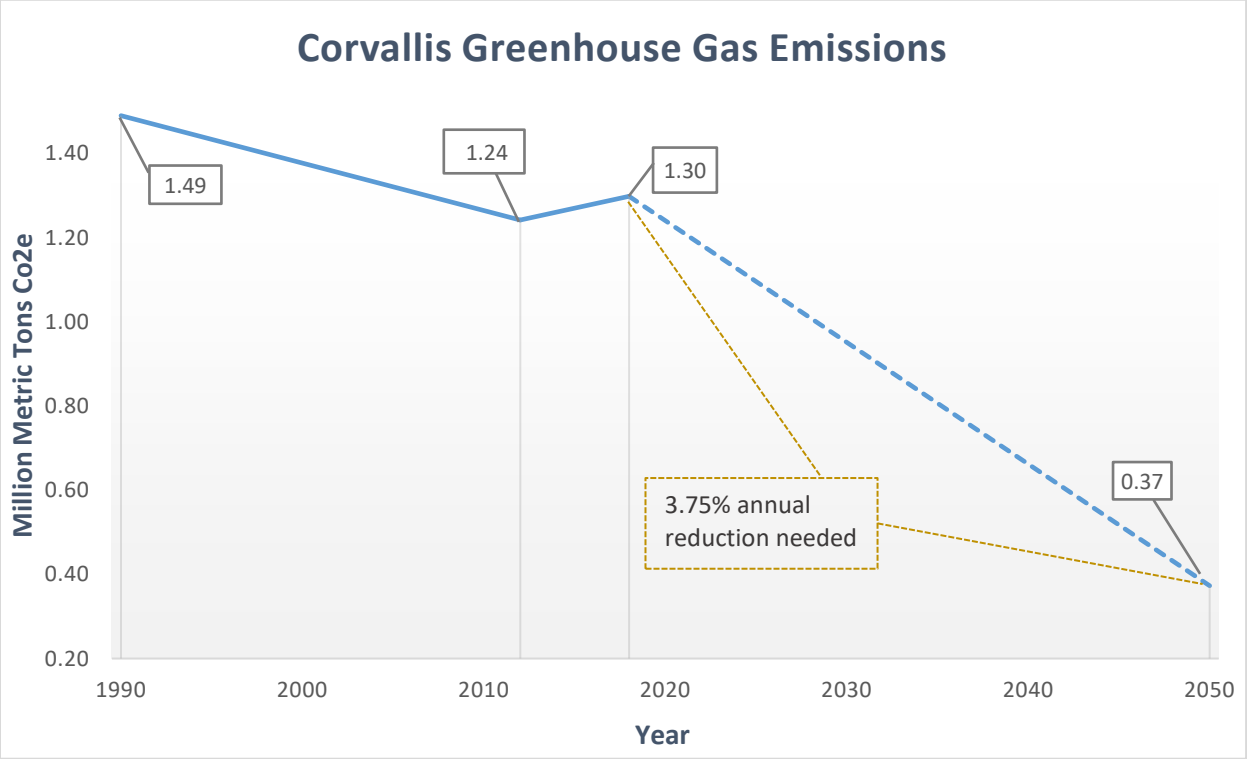
Executive Summary

In 2016, the Corvallis City Council adopted the Corvallis Climate Action Plan (CAP) in which the City set a goal to reduce the community's greenhouse gas emissions 75% below 1990 levels by 2050. The CAP describes actions for adaptation and mitigation of climate change through a range of municipal and community wide action points. In order to better understand our community's emissions and progress toward the CAP's target, the City of Corvallis has completed a Community Greenhouse Gas (GHG) Inventory for the 2018 calendar year.

Figure 1. Corvallis Emissions over Time



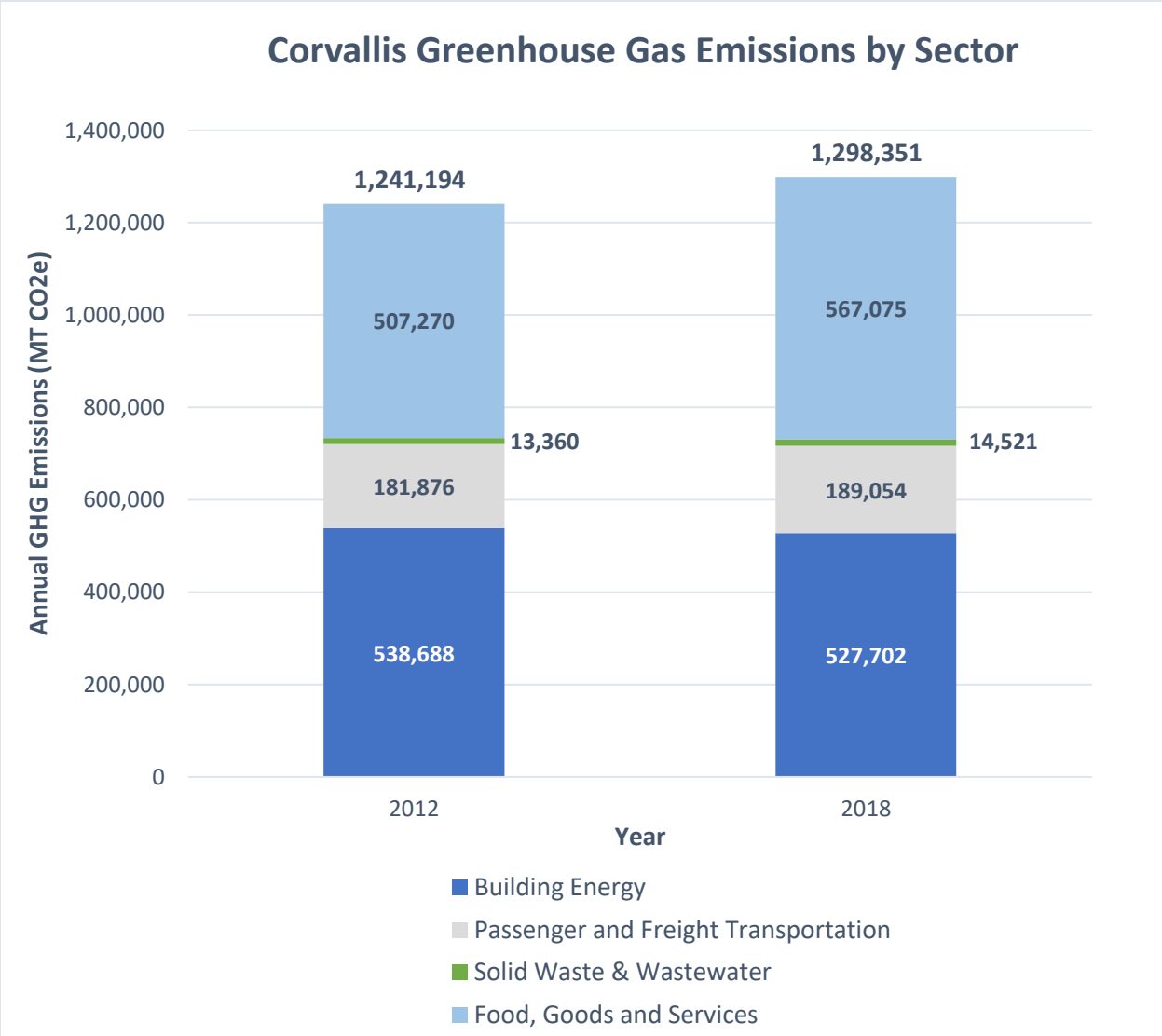
Total emissions in 2018 for the Corvallis community are estimated at 1,298,351 metric tons of carbon dioxide equivalent (MT CO_2e), roughly 57,157 MT CO_2e higher than 2012. This represents an approximate 4.6% increase in emissions compared to 2012, while the population of Corvallis increased 7.7% in the same time. [1] In order to reach the community's emissions goals, the 2018

[1] Portland State University, "Population Estimates and Reports." https://www.pdx.edu/prc/population-reports-estimates

level of emissions would have to decrease by over 70% in the next thirty years, or by 3.75% year-over-year.

As depicted in Figure 2, the largest source of emissions in Corvallis is the consumption of food, goods, and services, which was responsible for nearly half of all emissions from our community. Consumption is also the fastest growing source of emissions. This finding is in agreement with findings by the State of Oregon that show emissions from consumption-related activities are on

Figure 2. Corvallis Emissions by Sector in 2012 and 2018



the rise.[2] It is important to note that the transportation and consumption calculations in this report were completed using aggregated data, rather than data based on actual measured behavior of Corvallis residents, so confidence in the reported emissions is lower than that of other categories. The estimation that food, goods, and services account for almost half of our community's emissions suggests that both a closer examination of these emissions and their sources, and a concerted effort to reduce them, should be prioritized.

From 2012 to 2018, the City of Corvallis increased in population by approximately 7.7% from 55,065 to 59,280. Total emissions have risen at a lower rate than population growth, at an estimated 4.6%. However, in several areas, emissions increased at a higher rate than population growth. Personal and commercial vehicle related emissions rose 9.1%, solid waste increased by 8.9%, and consumption (food, goods, and services) increased by an estimated 11.8%. Furthermore, while emissions associated with electricity use decreased, per capita electricity usage increased from 2012 to 2018. The reduction in emissions is attributed to the availability of cleaner electricity sources, rather than a behavioral change within the community. These numbers indicate a trend that must be reversed if the community is to reach its climate goals.

[2] State of Oregon Department of Environmental Quality, "Oregon's Greenhouse Gas Emissions through 2015: An assessment of Oregon's sector-based and consumption-based greenhouse gas emissions." https://www.oregon.gov/deq/FilterDocs/OregonGHGreport.pdf

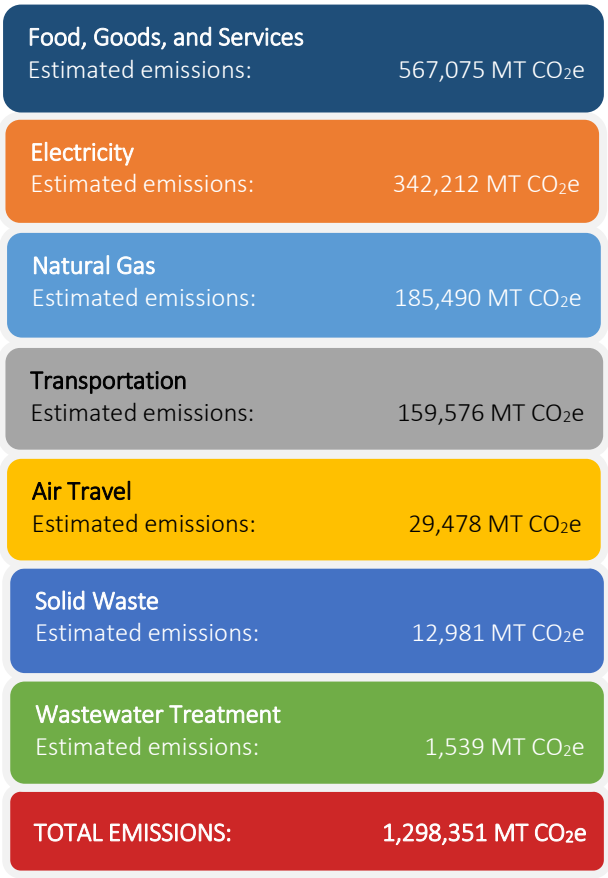
Community Greenhouse Gas Inventory Report

CORVALLIS, OR | REPORT FOR JANUARY – DECEMBER 2018

Introduction

In 2016, the Corvallis City Council adopted the Corvallis Climate Action Plan (CAP) in which the City committed to reducing greenhouse gas emissions 75% below 1990 levels by 2050.The CAP set several goals for the City, including one to "establish and monitor greenhouse gas emissions reduction targets for the Corvallis community." To better understand our community's emissions and identify ways the community can progress toward the CAP's target, the City of Corvallis has completed a Community Greenhouse Gas Inventory for the 2018 calendar year. This inventory can be compared to future inventories as they are completed, as well as to the previous inventory for calendar year 2012. The following sections discuss the overall findings of the report.

Figure 3. Summary of 2018 Emissions



2018 Greenhouse Gas Emissions

Total emissions in 2018 for the Corvallis community are estimated at 1,298,351 Metric Tons Carbon Dioxide Equivalent (MT CO_2e). A breakdown of emissions in each category is shown in Figure 3 above and Table 1 below.

Table 1. Detailed Emissions Categories

Category	MT CO_2e
Building Energy	**527,702**
Natural Gas and Upstream Emissions	185,490
Electricity and Upstream Emissions	342,212
Solid Waste and Wastewater	**14,521**
Solid Waste	12,981
Wastewater Treatment	1,539
Passenger and Freight Transportation	**189,054**
Transportation	159,576
Air Travel	29,478
Foods, Goods, and Services	**567,075**
Total	**1,298,351**

As noted previously, consumption of food, goods, and services is estimated to be nearly half of all community emissions. According to the Oregon Global Warming Commission,[3] household-based consumption is on the rise throughout the state, due to globalization and the post-recession economy. Consuming less and

Table 2. Per Capita Emissions for 2018

Category	2018 Emissions Per Capita (MT CO_2e)
Food, Goods, and Services	9.57
Electricity	5.77
Natural Gas	3.13
Transportation	2.69
Air Travel	0.50
Solid Waste	0.22
Wastewater Treatment	0.03
Total	21.90

[3] Oregon Global Warming Commission, "2018 Biennial Report to the Legislature", pp. 7, 10-11. https://www.keeporegoncool.org/reports

purchasing more local products and services is one way to decrease emissions related to household consumption.

Per Capita Emissions

While most emissions reduction targets focus on overall emissions, per capita emissions can be helpful when comparing changes over time, or when comparing our results to the efforts of other communities. In 2018, the Corvallis community generated 21.90 MT CO_2e per capita. Table 2, above, shows a breakdown of that number in each category.

Methodology

This inventory, consistent with the 2012 Community Greenhouse Gas Inventory Report, was completed using the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions.[4] This protocol was developed by ICLEI – Local Governments for Sustainability and updated in July 2019. Corvallis city limits serve as the physical boundaries except where otherwise noted. The reporting period for emissions calculations is the 2018 calendar year.

Emissions sources included in the inventory cover the broad categories of stationary fuel emissions, electricity, transportation, solid waste, and the emissions associated with household and government consumption of food, goods and services. Government consumption was provided by the City of Corvallis. Household consumption was estimated using the CoolClimate Network's carbon footprint estimator.[5] The numbers used were based on 2018 median household income and size, however the calculation was done in 2020, therefore the estimates provided by CoolClimate may not precisely align with consumptive habits for the year of the inventory, given a possible change in calculation methodology.

Whenever possible, identical data sources and methodologies from the 2012 inventory were used. For ease of comparing the two inventories, the table in Appendix I details changes in either data source or methodology for each reporting category. A complete list of all data inputs and their sources are in Appendix II.

The emissions target for 2050 was set using an estimated level of 1990 emissions for the Corvallis community. The non-consumption emissions for 1990 were derived through per capita extrapolation of Oregon's non-consumption emissions for that year. Consumption emissions

[4] http://icleiusa.org/publications/us-community-protocol/
[5] CoolClimate Network, "Household Calculator." https://coolclimate.berkeley.edu/calculator.

were estimated based on 2018 and applied to 1990 in the same relative proportions.

Emissions by Category

The categories in this inventory are electricity use, stationary fuel (natural gas) combustion, passenger vehicles, service and freight vehicles, public transit, air travel, community-generated solid waste sent to the landfill, landfill process emissions, wastewater emissions, and food, goods, and services.

Electricity Use

This category estimates emissions associated with the production of electricity used in the community. Corvallis has two electricity providers, Pacific Power and Consumers Power, Inc. Oregon has retail electricity choice options for large commercial and industrial customers, but not for residential, therefore in Corvallis, the power provider is determined by the customer's address. Consumers Power, Inc., which has a smaller service area in Corvallis, sourced most of its electricity from Bonneville Power Administration and other hydropower resources in 2018 and had a relatively low emissions factor. Pacific Power, which had a resource mix made up of nearly three-quarters fossil fuel sources, had a higher emissions factor in 2018.

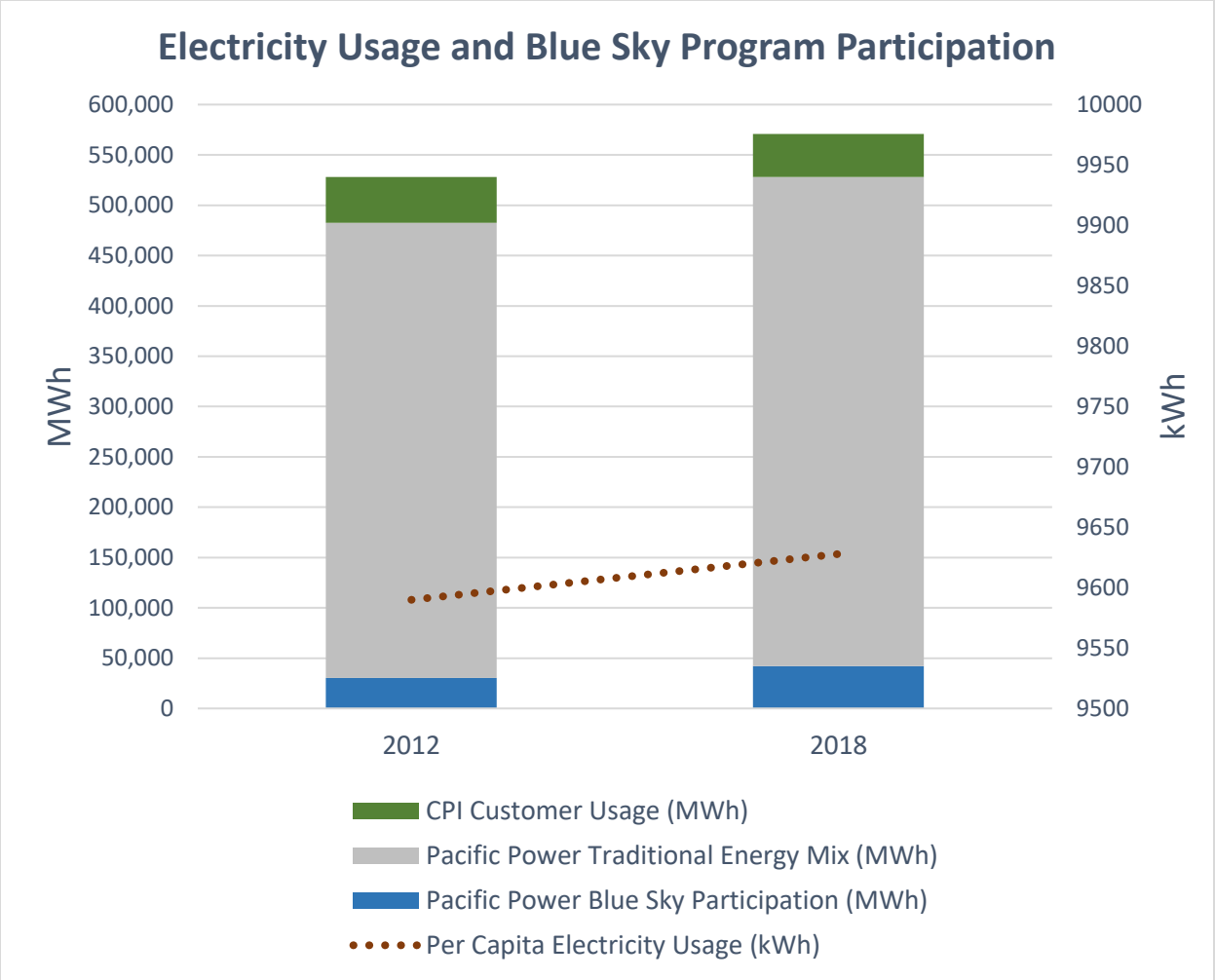
Table 3. Emissions from Electricity Use

Emissions from Electricity Use						
	Usage data		Emissions factors			Method
	Value	Unit	Value	Unit	Source	
Pacific Power	528,170	MWh*	0.6840	MT CO_2e/MWh	PacifiCorp	BE 2.1
Consumers Power Inc.	39,977		0.0123		BPA	
	2,593		0.2918		eGRID	
Total Emissions						311, 378 MT CO_2e
Method and data source notes: Usage data for 2018 from Pacific Power and Consumers Power. Emissions factors for Pacific Power from PacifiCorp for 2018 and for Consumers Power from eGRID's NWPP WECC emissions factors for 2018.[6] *MWh = Megawatt hour = 1,000 Kilowatt hours (kWh)						

[6] EPA's eGRID2018 Data File downloaded from https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

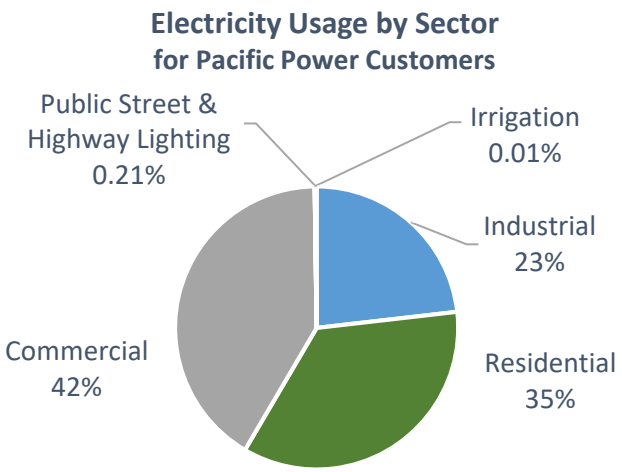
Pacific Power customers can choose to participate in the Blue Sky Program, in which customers pay an additional amount on their monthly bill to purchase renewable energy credits for a certain amount of kilowatt hours or equal to the amount of electricity they use. In 2018, Blue Sky usage and customer generated net-metered solar accounted for 51,867 MWh of electricity. The methodology used for this report recommends calculating emissions for gross energy use, without discounting renewable energy credits or carbon offsets. Figure 4 shows the change in the proportion of customers purchasing Blue Sky credits as a total of all electricity usage, as well as the per capita electricity usage for Corvallis residents. It should be noted that while emissions associated with electricity use decreased, per capita electricity usage *increased* from 2012 to 2018. The reduction in emissions is attributed to the availability of cleaner electricity sources, rather than a behavioral change within the community.

Figure 4. Corvallis Community Electricity Usage



Data on electricity usage for residential, commercial, and industrial customers, as well as usage for irrigation and street lighting were available from Pacific Power. Similar data for Consumers Power, Inc. customers were not available. Approximate usage by sector is shown in Figure 5 based on Pacific Power's sector data. Pacific Power provides about 92.5% of the electricity used in Corvallis.

Figure 5. Electricity Usage by Sector



Electric Power Transmission and Distribution Losses

When electricity is transmitted through power lines, a certain amount is lost as heat. In 2018, electricity consumption in Corvallis resulted in 7,995 MT CO_2e from this source.

Table 4. Emissions from Electric Power Grid Loss

Electric Power Transmission and Distribution Losses						
	Activity data		Emissions factors			Method
	Value	Unit	Value	Unit	Source	
Community electricity use	570,740	MWh	4.80	Grid Gross Loss (%)	eGRID	BE 4.1
Total Emissions						7,995 MT CO_2e
Method and data source notes: From EPA's eGRID2018 Data File downloaded from https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.						

Stationary Fuel Combustion

This category covers activities which directly combust fuels for the production of heat for space heating, process heating, and cooking. While there are multiple types of fuels used for these applications, in Corvallis, natural gas is by far the most widely used. NW Natural is the sole supplier of natural gas to the community, so usage data for this category were relatively easy to obtain. Usage data for other fuel types, from biomass fuels such as wood to petroleum products like distillate fuel oils, are much more difficult to gather and were not included in this inventory.

Corvallis generated 149,923 MT CO_2e from the consumption of natural gas in 2018. When combined with upstream emissions for this fuel source (see below), natural gas was responsible for 13.7% of all emissions.

Table 5. Emissions from Stationary Fuel Combustion

Emissions from Stationary Fuel Combustion						
	Usage data		Emissions factors			Method
	Value	Unit	Value	Unit	Source	
Natural gas	2,823,115	MMBtu*	.05302 CO_2 5 x 10^{-6} CH_4 1x10^{-7} N_2O	MT/MMBtu	Protocol	BE 1.1
Total Emissions						149,923 MT CO_2e
Method and data source notes: Therms provided by NW Natural for usage in 2018 multiplied by Pipeline (US Weighted Average) emission factor found in the Community Wide Protocol Appendix C Table B.1 *MMBtu = one million British Thermal Units (BTU)						

NW Natural offers a carbon offset purchase option to its customers. The program, called Smart Energy, allows customers to pay an additional amount on their gas bill to contribute to the funding of projects like anaerobic biodigesters on commercial farms, which create biogas out of animal waste, thus lessening the amount of methane released into the air. As with the purchase of renewable energy credits through Pacific Power, the methodology for this report recommends against including carbon offsets in emissions totals. In 2018, the Corvallis community purchased approximately 131,000 MMBtu worth of carbon offsets, or approximately 6,957 MT CO_2E.

Figure 6. Natural Gas Usage

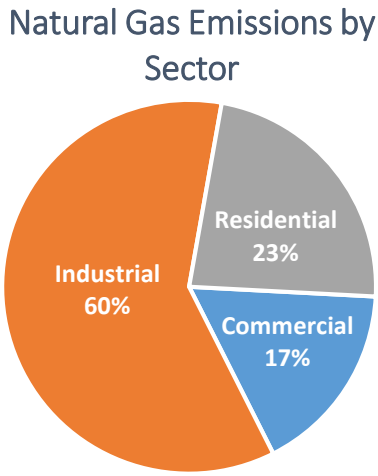


Table 6. Natural Gas Usage

Natural Gas Usage by Sector			
	Industrial	Residential	Commercial
Usage (MMBtu)	1,701,551	649,643	471,921
Emissions (MT CO_2e)	90,305	34,532	25,085

Upstream Emissions from Stationary Fuel Combustion

This category considers the energy used to extract, process and deliver fuels (in this case, natural gas) to the combustion point. These emissions refer only to the process of producing fuels, not the emissions associated with infrastructure, such as mines or refineries, or disposal of spent fuels.

These upstream emissions amounted to 35,567 MT CO_2e in 2018, with total emissions from natural gas amount to 185,490 MT CO_2e.

Table 7. Upstream Emissions Associated with Natural Gas Usage

Upstream Emissions from Stationary Fuel Combustion						
35,567 MT CO_2e	Activity data		Emissions factors			Method
	Value	Unit	Value	Unit	Source	
Natural Gas	2,823,115	MMBtu	445	Kg CO_2e / Thousand Cubic Meters	Protocol	BE 5.1
Total Emissions						35,567 MT CO_2e
Method and data source notes: 2018 natural gas usage provided by NW Natural. Upstream emissions factors used in Protocol obtained from National Renewable Energy Laboratory (2007) and Oregon Department of Environmental Quality (2012).						

Transportation: Passenger Vehicles and Freight/Service Trucks

This category contains two sub-categories: passenger vehicles, and freight and service trucks. Passenger vehicle emissions consist of direct emissions from the combustion of petroleum-based fuels by internal combustion engine passenger cars and light duty trucks. Freight and service truck emissions include direct emissions from freight and service on-road transportation, including medium and heavy-duty trucks.

For this inventory, ICLEI's Protocol was not used to estimate emissions due to the lack of necessary data. Instead, emissions were extrapolated from the most recent inventory year (2012) based on the percent increase in statewide vehicle miles traveled (VMT). The use of this method does not allow for analysis of observed changes in emissions since the last inventory, but it does allow us to estimate emissions from transportation and include them in our overall emissions count. To estimate the total emissions for 2018, we multiplied the total emissions from 2012 by a scale factor: $Emissions_{2018} = Emissions_{2012} * \frac{VMT_{2018}}{VMT_{2010}}$[7]

Then, the same breakdown from the 2012 inventory was applied to the 2018 total emissions estimate to determine emissions in the sub-categories provided in Table 9.

[7] The data used to complete the 2012 inventory was from 2010. For this reason, this equation uses statewide vehicle miles traveled from 2010 to calculate the scale factor.

Table 8. Estimated Emission from Transportation Sectors

	Percentage of Total Emissions	Estimated Emissions (MT CO_2e)
Passenger Vehicles	80.35%	127,238
Freight and Service Vehicles	19.65%	31,108
Total	100%	158,346

In 2018, our community generated approximately 127,238 MT CO_2e from passenger vehicles, and approximately 31,108 MT CO_2e from freight and service vehicles.

Public Transit

This category includes direct emissions from the combustion of a blend of petroleum and biodiesel fuel by internal combustion engine transit vehicles in the Corvallis Transit System. Actual fuel usage data was used to calculate related emissions. Emissions from fuel use for Benton County's special and regional transportation systems, such as Dial-A-Bus or the Linn-Benton Loop, were not included. In 2018, the Corvallis Transit System generated 1,230 MT CO_2e.

Table 9. Emissions from Public Transit

Emissions from Public Transit			
	Activity data		Method
	Value	Unit	
Transit	97,357	gallons biodiesel (B5)	E3 Fleet Emissions Calculator
Total Emissions			1,230 MT CO_2e
Method and data source notes: 2018 City of Corvallis transit fuel usage data used in E3 Fleet's Emissions Calculator[8]. The calculator results are estimates, using emission factors and assumptions from Natural Resources Canada's GHGenius v3.14 model, and include the entire life-cycle of the fuels.			

Air Travel

This category is a component of the consumption-based emissions accounting, which estimates the global emissions associated with household purchases and use of products and services. Estimates were produced using the CoolClimate Calculator and the number of households in the community. The Calculator's results estimated the average Corvallis household contributes 1.21

[8] https://www.e3fleet.com/emissions_calculator.html

MT CO_2e each year through air travel. U.S. Census Bureau data puts the number of households at 24,362 in Corvallis for 2018.[9]

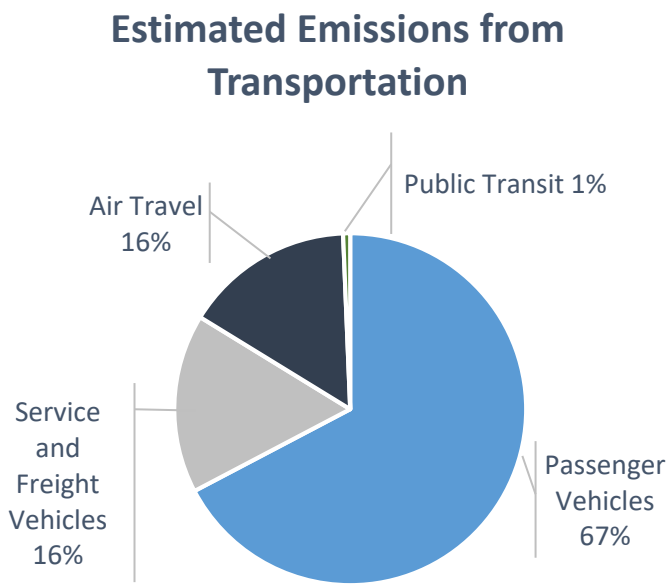
Table 10. Estimated Emissions Associated with Air Travel

Estimated Emissions from Air Travel			
	Activity data		Method
	Value	Unit	
Air Travel	1.21	MT CO_2e / household	CoolClimate Carbon Footprint Calculator by University of California, Berkeley
Total Emissions			29,478 MT CO_2e
Method and data source notes: Emissions estimates obtained from the CoolClimate Carbon Footprint Calculator, then Air Travel emissions itemized separately. Household unit data from U.S. Census Bureau.			

Transportation Summary

Overall, transportation emissions, including air travel, account for almost 15% of the community's GHG emissions in 2018. The chart on the right shows the various sources of transportation emissions and their contribution to the total.

Figure 7. Transportation Emissions



Wastewater

Wastewater treatment processes create emissions when microorganisms degrade the soluble organic material in wastewater under anaerobic conditions, creating methane (CH_4) and nitrous oxide (N_2O) and carbon dioxide (CO_2). During collection and treatment, wastewater may be unintentionally or deliberately managed under anaerobic conditions, potentially releasing some uncaptured or uncombusted CH_4 into the environment.

[9] United States Census Bureau, "American FactFinder." https://factfinder.census.gov/bkmk/cf/1.0/en/place/Corvallis city, Oregon/HOUSING

Emissions in this category were obtained from the 2018 City of Corvallis Greenhouse Gas Inventory for Municipal Government Operations.[10] In 2018, the Corvallis community generated 1,539 MT CO_2e in greenhouse gas emissions from the treatment of wastewater, which amounted to less than 1% of total community emissions.

Community-Generated Waste Sent to Landfills

This category determines emissions from waste disposed of by a community's population. In this case, our community waste disposal service, Republic Services, provides data for disposal in all of Benton County, without the ability to differentiate waste coming from Corvallis alone. Therefore, figures on municipal solid waste (MSW) are greater are attributed to the whole of Benton County, in keeping with the methodology used in the 2012 community inventory. Because of the lack of widely accepted and standardized data and guidance, the ICLEI Protocol does not include methodologies to estimate emissions from composting.

In 2018, our community's waste resulted in emissions of approximately 12,271 MT CO_2e. Combined with landfill process emissions (below), our community's solid waste disposal represents about 1.0% of total emissions.

Table 11. Emissions from Municipal Solid Waste

Community-Generated Waste Sent to Landfills						
	Activity data		Emissions factors			Method
	Value	Unit	Value	Unit	Source	
Community Waste to Landfills	43,285	Wet short tons	0.06	MT CH_4 / wet short ton	Protocol	SW.4
			0.75	Landfill Gas collection efficiency		
			0.1	Oxidation rate		
Total Emissions						12,271 MT CO_2e
Method and data source notes: Corvallis community waste tonnage reported in Republic Services 2018 Annual Report.						

Process Emissions Associated with Landfilling

To get a complete picture of the emissions associated with landfilling, it is important to include transport emissions and process emissions, which come from powering the equipment needed to manage the landfill. In 2018, emissions from this source resulted in 710 MT CO_2e. The emissions related to solid waste *collection* and *transportation* are another source of GHG emissions. Those

[10] https://www.corvallisoregon.gov/publicworks/page/organizational-greenhouse-gas-inventories

are already accounted for in the emissions associated with freight and service trucks and were not itemized separately.

Table 12. Emissions Associated with Landfilling

Process Emissions Associated with Landfilling						
	Activity data		Emissions factors			Method
	Value	Unit	Value	Unit	Source	
Process Emissions Associated with Landfilling	43,285	Wet short tons	0.0164	MT CO_2e / wet short ton	Protocol	SW.5
Total Emissions						710 MT CO_2e
Method and data source notes: Corvallis community waste tonnage reported in Republic Services 2018 Annual Report.						

Household and Government Supply Chain Emissions

A household carbon footprint can be understood as the greenhouse gas emissions resulting from the production, use and disposal of everything the household consumes in a year, including household energy, transportation, food, goods and services. A household consumption inventory for the entire community is simply the sum of all of the carbon footprints for all households in the community. Because precise data were available for certain categories of consumption, like electricity usage and waste, those are excluded from the following estimations. This category includes only that which could not be estimated elsewhere. The methodology used to estimate supply chain emissions is based on average emissions factors for various sectors of the U.S. economy. Consumption emissions for an average Corvallis household were obtained from the CoolClimate calculator. As mentioned above, some categories in the calculator were omitted in order to eliminate double counting of emissions. Those categories have been noted below.

Figure 8. Categories Included in Consumption Estimations

Included in Household Consumption	Not included in Household Consumption
Car manufacturing	Car fuel
Construction	Water
Food	Natural gas
Goods	Electricity
Services	Other fuels
Note: Air travel is included as its own separate category rather than as a part of Household Consumption.	

Emissions estimates for the Government Supply Chain were obtained from the 2018 City of Corvallis Greenhouse Gas Inventory for Municipal Government Operations, which used the Local Government Operations Protocol. In 2018, combined household and government supply chain emissions totaled 633,168 MT CO_2e. This amount represents approximately 47% of the community's total emissions.

Table 13. Supply Chain Emissions

Household and Government Supply Chain Emissions			
	Activity data		Method
	Value	Unit	
Household Supply Chain Emissions	23.1	MT CO_2e per household	CoolClimate Carbon Footprint Calculator
Government Supply Chain Emissions	4,800	MT CO_2e	EIO-LCA
Total Emissions			567,075 MT CO_2e
Method and data source notes: Household Supply Chain emissions obtained using the CoolClimate Carbon Footprint Calculator. Household unit data from U.S. Census Bureau. Government Supply Chain Emissions calculated for 2018 using EIO-LCA methodology, as reported in the 2018 City of Corvallis Greenhouse Gas Inventory for Municipal Government Operations.			

Comparison of GHG Emissions from 2012 and 2018

Total emissions in 2018 for the Corvallis community are estimated at 1,298,351 MT CO_2e. This represents a 5% increase in emissions compared to 2012. While any increase in emissions brings us further away from meeting the goals laid out in the CAP, it is important to note that population size for Corvallis over the six-year period between inventories also increased by about 7.7%. The chart below summarizes emissions in each category for both 2012 and 2018.

Table 14. Total Emissions by Category

Category	2012 *MT CO_2e*	2018 *MT CO_2e*	Change *MT CO_2e*	Change *as a %*
Natural Gas and Upstream Emissions	184,003	185,490	1,487	0.8%
Electricity and Grid Loss	354,684	342,213	-12,471	-3.5%
Passenger, Service, and Freight Vehicles	145,135	158,346	13,211	9.1%
Public Transit	1,138	1,230	92	8.1%
Air Travel	35,603	29,478	-6,125	-17.2%
Municipal Solid Waste and Process Emissions	11,924	12,981	1,057	8.9%
Wastewater Emissions	1,436	1,539	103	7.2%
Food and Goods	507,270	567,075	59,805	11.8%
Total Emissions	**1,241,194**	**1,298,351**	**57,158**	**4.6%**

Figure 9. Changes in Community Emissions from 2012 to 2018

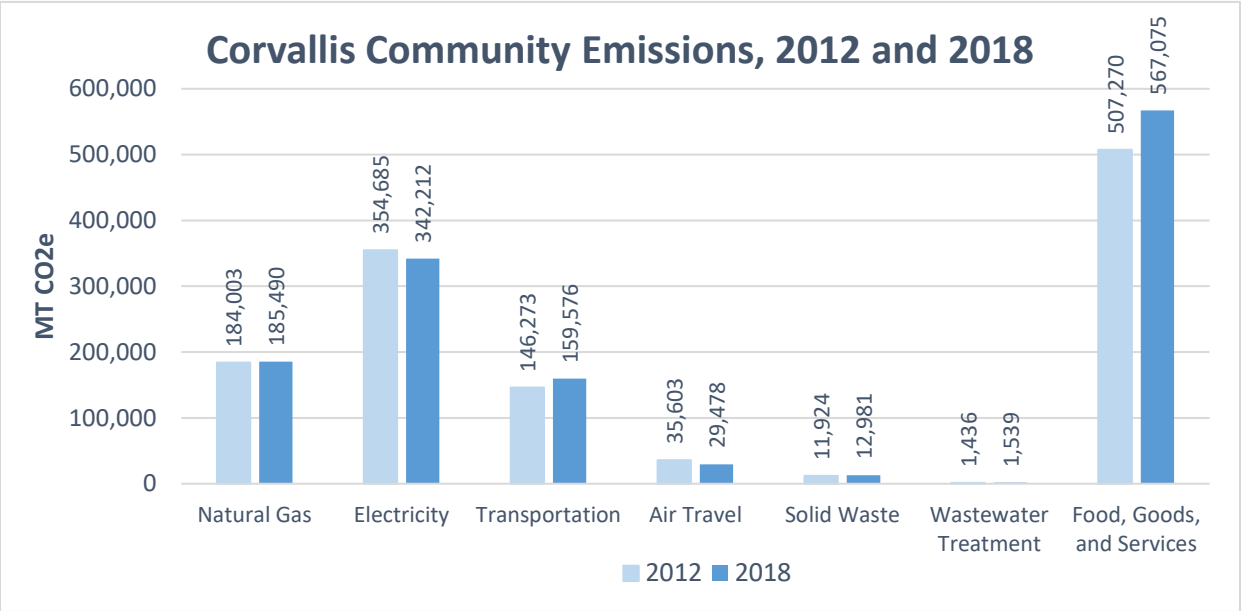


Table 15. Per Capita Emissions by Category

Category	2012 *MT CO_2e*	2018 *MT CO_2e*	Change *MT CO_2e*	Change *as a %*
Natural Gas and Upstream Emissions	3.34	3.13	-0.21	-6.4%
Electricity and Grid Loss	6.44	5.77	-0.67	-10.4
Passenger, Service, and Freight Vehicles	2.64	2.67	0.03	1.3%
Public Transit	0.02	0.02	0.00	0.0%
Air Travel	0.65	0.5	-0.15	-23.1%
Municipal Solid Waste and Process Emissions	0.21	0.22	0.01	1.1%
Wastewater Emissions	0.03	0.03	0.00	-0.4%
Food and Goods	9.21	9.57	0.35	3.8%
Total Emissions	22.54	21.90	-0.64	-2.9%

Emissions Changes to Note

Some sources of emissions increased or decreased disproportionately to the 7.7% population growth. These categories with significant changes are discussed below.

Food, Goods, and Services

This category increased at an amount disproportionate to population growth. While this finding is in agreement with inventories from Oregon and around the country that show emissions from

consumption are on the rise, it is important to note that the methodology used in this inventory makes use of national, aggregated data, rather than data specific to Corvallis community members. Additionally, the methodology for the CoolClimate calculator may have changed between 2012 and 2018. For this reason, confidence in the estimated emissions is relatively lower than other categories. Generally, however, the Oregon Global Warming Commission attributes the rise in Oregon's consumption levels to an improving post-recession economy and a higher demand for goods shipped from overseas. As globalization gives rise to overseas manufacturing and makes international products inexpensive and accessible, emissions related to food and goods supply chains increase. For a thorough analysis of trends in statewide consumption and the resulting emissions, see the Oregon Department of Environmental Quality's 2015 Greenhouse Gas Inventory.

Air Travel

Estimated emissions from air travel decreased by 17.2% from the 2012 Corvallis GHG inventory and still make up less than 3% of overall community emissions. However, the same methodology described in the previous section was used to determine emissions from air travel so confidence in the estimated emissions in this category is lower than other categories. These numbers are based on national averages from the CoolClimate calculator, so are not necessarily representative of Corvallis community members' behavior.

Solid waste

Emission from solid waste and its processing rose 8.9% between 2012 and 2018, which is disproportionate to the 7.7% population increase over the same time period. Between 2012 and 2018, residential mixed solid waste decreased slightly from 13,626 wet short tons to 12,992 wet short tons, while commercial and industrial waste increased from 26,134 wet short tons to 30,294 wet short tons. In that time, residential recycling increased slightly, by about 100 tons, while commercial recycling decreased.[11]

[11] In January 2018 China enacted their National Sword Policy, which saw a significant decrease in the amount of plastic and other recyclable material they would purchase from other countries. For a full breakdown of international recycling purchasing, see Republic Services' City of Corvallis Annual Report from 2018.

Electricity Use and Related Transmission and Distribution Losses

It is important to note that while emission associated with electricity usage went down, both overall and per capita, electricity usage per capita actually increased (see Figure 4). The reason for the decrease in emissions can actually be attributed to the changes in Pacific Power's energy resource mix from 2012 to 2018, meaning that their emissions factor decreased as their portfolio included more clean energy sources. Overall, however, the community's electricity use increased during that time.

Conclusion

The goal of this community-wide greenhouse gas inventory is to gather information on greenhouse gas emissions and present it in a way that is beneficial and understandable for the community and policymakers. The report identifies major sources and activities that contribute to greenhouse gas emissions, using specific data where available, and estimations where specific data cannot be measured.

Results from this inventory can be used to identify priorities for the Corvallis community as it strives to reduce greenhouse gas emissions. Additionally, results from this report should be used in comparison with future reports to track progress towards local emissions reductions goals and other objectives set forth by the Climate Action Plan.

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Appendix I: Changes in Methodology

Category	Data Source	Methodology[12]
Natural Gas	No change	BE 1.1 (No change)
Electricity Usage	No change	BE 2.1 (No change)
Electric Power Transmission and Distribution Losses	No change	BE 4.1 (No change)
Upstream natural gas	No change	BE 5.1 (No change)
Passenger Vehicles	(New): No data for 2018 exists. Emissions for 2018 were extrapolated from 2012 inventory results based on Corvallis population change and statewide vehicle miles traveled	
Service and Freight Vehicles	(New): No data for 2018 exists. Emissions for 2018 were extrapolated from 2012 inventory results based on Corvallis population change and statewide vehicle miles traveled	
Public Transit	No change	(New): E3 Fleet Emissions Calculator
Air Travel	No change	CoolClimate Carbon Footprint Calculator[13]
Community-generated solid waste to landfill	No change	SW.4 (No change)
Process emissions associated with landfilling	No change	SW.5 (No change)
Wastewater emissions	No change	(New): Local Government Operations Protocol[14]
Food, goods, and services	No change	CoolClimate Carbon Footprint Calculator (No change)

[12] BE and SW methods refer to the ICLEI sections referenced to calculate emissions for these categories.

[13] The CoolClimate Carbon Footprint calculation methodology is continuously tweaked and updated. It is likely the methodology for calculation has changed since 2012.

[14] Local Government Operations Protocol for the quantification and reporting of greenhouse gas emissions inventories. May 2010. https://ww3.arb.ca.gov/cc/protocols/localgov/pubs/lgo_protocol_v1_1_2010-05-03.pdf

Appendix II: Data Inputs

Report Category	Data Input		Value	Units	Source	Notes
Electricity	Electricity Usage		528,170,833	kWh	Pacific Power	For tax district 1015
			42,569,661	kWh	Consumers Power, Inc.	
	Emissions Factors for Electricity Usage		0.6840	MT CO_2e/MWh	Pacific Power	
			0.0123	MT CO_2e/MWh	Bonneville Power Administration	
			0.2972	MT CO_2e/MWh	Environmental Protection Agency[15]	CPI provided no value, so the value for eGRID sub region NWPP was used. It was converted from lb CO_2e to MT CO_2e.
			655.4	lb CO_2e/MWh		
	Grid Gross Loss		4.8	%		
Stationary Fuel Combustion	Natural Gas Usage by Sector	Residential	6,496,432	Therms	NW Natural	Transport customers purchase fuel from a third party supplier, which is then *transported* to the customer by NW Natural.
		Commercial	4,719,215	Therms	NW Natural	
		Industrial	791,871	Therms	NW Natural	
		Transport	16,223,636	Therms	NW Natural	
	CO_2 Emissions Factor for Natural Gas combustion		53.02	kg CO_2/MMBtu	Protocol: Appendix C Table B.1[16]	Used value for US weighted average
	CH_4 Emissions Factor by Sector	Industrial	0.001	kg/MMBtu	Protocol: Appendix C Table B.3	
		Residential	0.005	kg/MMBtu	Protocol: Appendix C Table B.3	
		Commercial	0.005	kg/MMBtu	Protocol: Appendix C Table B.3	
	N_2O Emissions Factor by Sector	Industrial	0.001	kg/MMBtu	Protocol: Appendix C Table B.3	
		Residential	0.001	kg/MMBtu	Protocol: Appendix C Table B.3	

[15] EPA, eGRID 2016 Summary Tables, Table 1: https://www.epa.gov/sites/production/files/2018-02/documents/egrid2016_summarytables.pdf
[16] ICLEI, US Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions: http://icleiusa.org/publications/us-community-protocol/

		Commercial	0.001	kg/MMBtu	Protocol: Appendix C Table B.3	
Upstream Emissions from Natural Gas	Upstream Emissions Factor		445	kg/1000 m^3	Protocol: Appendix C Table B.13	
Public Transit	Fuel use from public transit	Biodiesel (B5)	97,357	Gallons	City of Corvallis, Public Works	In some years, the City uses a mix of different fuels. In 2018, *only* B5 was used.
Report Category	**Data Input**		**Value**	**Units**	**Source**	**Notes**
Passenger Vehicles	Statewide Vehicle Miles Traveled	2010	33,774,100,000	VMT	Oregon Department of Transportation[17]	2018 emissions from transportation were extrapolated from 2012 emissions, which was based on data from 2010.
Service and Freight Vehicles		2018	36,848,400,000			
Air Travel	Air travel		N/A	N/A	CoolClimate Carbon Footprint Calculator by University of California, Berkeley[18]	Corvallis, OR, was selected as location; 2.5 was selected for household size and $50,000 for income. Air travel was itemized separately. Some categories were removed to prevent double-counting.
Food and Goods	Household Consumption		N/A	N/A		
	Government Consumption		N/A	N/A	City of Corvallis[19]	Both of these categories were already calculated in the City's organizational inventory.
Wastewater	Treatment of wastewater		N/A	N/A		
Community-generated Waste Sent to Landfills	Community waste landfilled		43,285	Wet Short Tons	Republic Services[20]	Republic Services annual report includes waste from all of Benton County
	Emissions Factor for Mixed MSW		0.060	MT CH_4 / wet short ton	Protocol: Appendix E, Table SW.5	
	Landfill Gas collection efficiency		75	%		

[17] Oregon Department of Transportation, Oregon Statewide Vehicle Miles Traveled, 1979-2018: https://www.oregon.gov/ODOT/Data/documents/VMT_Statewide.pdf
[18] University of California, Berkeley; CoolClimate Carbon Footprint Calculator: https://coolclimate.berkeley.edu/calculator
[19] City of Corvallis, 2018 City of Corvallis Greenhouse Gas Inventory for Municipal Government Operations: https://archives.corvallisoregon.gov/internal/ElectronicFile.aspx?dbid=0&docid=1489041
[20] Republic Services, 2018 Annual Report: City of Corvallis.

	Oxidation Rate		10	%	Protocol: Appendix E, SW.1.1 Calculation Method	
Landfill Process Emissions	Emissions Factor		0.0164	MT CO_2e / wet short ton	Protocol: Appendix E, Equation SW.5	
Corvallis Demographic Information	Population	2010	54,462	People	Portland State University[21]	2010 population data was used in the transportation calculation.
		2018	59,280			
	Households	2018	24,362	Households	US Census Bureau[22]	

[21] Portland State University, College of Urban & Public Affairs, Population Research Center: http://www.pdx.edu/prc/population-reports-estimates
[22] US Census Bureau: https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml?src=bkmk